to show how hopeful even the most hopelessly appearing were. Some have been paralyzed four, five and ten years, and then have made a recovery; some have had grave eye lesions—pupillary disturbance, optic nerve atrophy, and have made a fair recovery, one had marked cystitis and a single irrigation afforded permanent relief—I have notes before me now of grave myelitis wherein perfect recovery is recorded.

135 E. FORTY-SECOND STREET,
NEW YORK.

ART. V.—A CONTRIBUTION TO THE PATHOLOGICAL ANATOMY OF DISSEMINATED CEREBRO-SPINAL SCLEROSIS.

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(*A paper before New York Neurological Society, Feb.*, 1878.)

MR. PRESIDENT AND GENTLEMEN: This thesis is based upon two cases. Case I. came under the observa- of Dr. Van Derveer, of Albany; the history is as follows:

Thos. Grogan, accountant, æt. 29, unmarried. Mother died at the age of 49, during her climacteric period, from the exhaustion following sciatica. One brother died of phthisis pulmonalis at the age of 26. Several brothers and sisters died during infancy. The father, a brother and a sister are still living, and in good health. Saw the case first in Feb., 1870, when the following facts were elicited:

Habits have always been good; no sexual excess or masturbation, and has not been exposed to venereal diseases. Has been quite studious and had acquired a good education. Was fond of society, and spent many of his evenings at dances up to the time he was taken sick.

In the latter part of December, 1867, his attention was first attracted to a sharp pain about an inch back of the right eye. He was impressed with the idea that he had strained the eye and began wearing a pair of spectacles. While attempting to hang a picture, he noticed that he could not see it distinctly enough to determine whether it was hung properly or not. In April, 1868, had frequent nocturnal emissions, but did not apply for treatment. While attending a military funeral in June, of this year, with a prominent organization of this city, he experienced no trouble in his power of locomotion until he had walked about five blocks, when he began to stagger like a drunken man, and after several ineffectual attempts to march steadily, was obliged to leave the ranks. He immediately returned home, and consulted his family physician, who thought that he was probably suffering from a partial sun-stroke. No particular treatment was ordered aside from rest, and partially recovering his strength he returned again to his office duties. In August he was much annoyed by a feeling of internal warmth in the lower part of the left leg, but adopted no treatment. Went to Pennsylvania in October to secure rest and recruit his health. Any unusual excitement at this time would cause severe nervous tremors and a sensation "akin to creeping of the flesh." During his visit he suffered much pain in the left ankle and thought he had sprained it, but could not tell when or how he had done so.

He returned to his home about Nov. 1st, and applied himself closely to business until the middle of February, 1869, when his strength failing he gave up business by the advice of his physician. Was confined to the house during three weeks, regarding his weakness as due to overwork. During the winter of 1868-'69, Dr. Alden March applied the moxa several times to his spine. At the close of his three weeks' confinement he was again able to take exercise in the open air, and walked with the aid of a cane. In the course of four or five weeks he was again much prostrated, so much so that he himself entertained serious apprehensions concerning his recovery. He was now troubled with more or less flatulence, dizziness, loss of sight and constipation. Improved somewhat in May, and continued so until the middle of August. Went to Sharon

Springs and took sulphur baths up to 100° Fahr. daily during four weeks, and drank at the same time from one to two quarts of sulphur water each day. This produced great prostration, and he was brought home in four weeks greatly debilitated, and much reduced in strength and flesh, and now for the first time in the history of his disease was he unable to walk without support. He first came under my observation in February, 1870, when he presented the following more prominent symptoms: Strength somewhat improved since his return from the Springs, and he can now, with great effort, walk alone, but gravitates in an irregular way from side to side while doing so. Complains of great weakness in his arms and legs, and a feeling of great constriction about the body. Cannot see to read, but can distinguish a friend at a distance across the street. His feet are very sensitive to tickling. Standing with his feet together, when his eyes are closed, he thinks he would fall if left alone. Will not trust himself to come down stairs without watching his feet closely, and feels a sensation as if walking upon cushions. Drags his feet when walking. Can converse with little or no effort. Enjoys conversation, is humorous, and fond of quoting from Shakespeare. Is unable to whistle on account of a spasmodic twitching of the muscles on the right side of the face when he attempts it. Can put out his tongue in all directions. Very difficult for him to attempt to pronounce the words, "truly moral." Generally sleeps well the latter part of the night; bowels constipated; pulse and respiration normal. Urine is passed without trouble, and at regular intervals in usual quantity; is acid, has a specific gravity of 1020; is heavily loaded with phosphates. Has seminal emissions from four to six times a month. Surface of skin is very hyperæsthesic. Upon strong percussion along the spinal tract, feels some pain. Ordered twenty minims fluid extract ergot three times daily, with good, generous diet, also directed him to take an occasional saline cathartic. Continued this treatment for three months and he thought he was improving, but, in fact, had not so good use of his limbs as before.

June 1. Can whistle somewhat more distinctly, but complains that he is losing control of his arms. Feeds himself with difficulty. When asked to touch his nose with either in-

dex finger, his hand describes a semi-circle, and as he approximates the finger to the nose, it is done with a sudden jerk.

Ordered a pill, consisting of 1-32 gr. strychnia, ¼ gr. capsicum, 1 gr. ferri hydrogen. redact., and, as he does not sleep, 15 grs. brom. potass., to be taken at bed time. Has frequent erections and great sexual desires. Urine still abundantly phosphatic in character. Continued the above treatment until Sept. 1st, with no amelioration, and a gradual loss of power of co-ordinating the lower limbs. Unable to walk alone, and walks with difficulty when supported; drags his legs along, advancing the heel first with a jerk. Ordered phosphor. acid and strychnia, with brom. potass. at night.

Dr. Clymer saw him about Oct. 1st, 1871, and observed the following more marked symptoms in his disease: Tone of voice drawling; brain seems weakened, and nystagmus of the eyeballs is apparent. Has, in addition, spinal epilepsy; it having only a general connection with the sclerosis. The latter condition only occasionally present. Sensation in both limbs impaired. The muscular will power in the right limb is good, but much weakened in the left, and in the latter, sensation is confused and tardy. Sensation of heat or cold, or the impression of a sharp instrument reaches the brain much sooner from the one part than another. There is characteristic dragging of the feet, and the will power is inadequate to give the proper stimulus to the muscles, yet he displays considerable control of the leg, when attempting to extend or flex it. Took most of the time until Oct., 1872, a pill, consisting of 1-50 gr. phosphor., 1-32 gr. strychnia, 1 gr. ferr. hyd. red., but with no apparent benefit. Oct. 1, 1872, Dr. Clymer saw him a second time. The spinal epilepsy still continues, but is not so marked. The muscular will power is much weakened. Has lost much in flesh, and at times there have been well marked symptoms of paralysis of the right side of the face. Cannot whistle and talks very indistinctly at times. Urine phosphatic in character and bowels much constipated. No nocturnal emissions; no sexual desires. Anæsthesia is very decided and sensation confused. Little treatment resorted to from this time until his death, except to keep his bowels regulated, and occasionally quinine to improve his appetite. Has to be fed, as he cannot

carry anything to his mouth, having little if any control of his hands. Sight much impaired. Three months before his death his urine was withdrawn several times, and then again a week previous to his death. It became very difficult for him to talk three months before his death, but at no time were well marked symptoms of aphasia observed. His trouble in speaking seemed to be due to paralysis of the muscles. In Sept., 1871, Dr. Stevens examined his eyes with the ophthalmoscope and diagnosticated sclerosis of the optic nerve.

Patient died Feb. 21st, 1874. At the autopsy—no general post-mortem being allowed—only the brain and spinal cord were examined, which were removed entire and sent to Dr. Seguin immediately.*

Case II. came under Dr. Seguin's observation.

Female, æt. 23. Single. Seen Oct. 20, 1873. A nervous girl, with occasional irregularity of menstruation, but no dysmenorrhœa. At times hysterical laughter and tears; never convulsive attack. In July, 1871, while out walking, after having climbed a number of walls, felt weak and awkward in right leg; thought she had sprained her knee. There is not enough evidence to support this statement. Ever since she has had weak right leg, without anæsthesia or numbness; at times more use of leg than at others; almost cured once or twice; of late has required help of crutch, or friend's arm in walking. When I examined Miss P., I found paresis of right leg, the loss of power being marked at ankle and toes. There was doubtful weakness of the right hand. I could not make out that the knee joint was affected. The muscles of the right leg showed a slight diminution of reaction to the faradic current, and this agent also showed that sensibility to pain was a little dull in leg and foot.

In view of the history of the case, the capricious development of the palsy, the absence of reliable signs of central disease, the presence of a strong neurotic element in the family, and the fact that strong emotions had been acting upon her, I concluded that the patient had a functional palsy of an hysterical nature. Strychnia was given her and faradism used.

* History by Dr. Van Derveer.

The specific effects of strychnia appeared and the patient was decidedly tetanized for a while; this passed off, and when I last saw the patient, on Dec. 11th, she was in about the same state as at the beginning of treatment. The unfavorable effects of the treatment led me then to believe that the patient had an obscure central lesion, probably sclerosis. In March or April, 1874, patient rapidly grew worse, becoming paraplegic, and her hands showing paresis. In July she was placed in an irregular water-cure house, where extensive bed sores formed in consequence of want of care and of cold applications to the palsied parts. (She had continuous applications for several days.) Exhaustion and pyemia caused death, August 1st. The post-mortem examination showed disseminated sclerosis of the spinal cord. The brain not examined. Dr. Chas. A. Leale, of this city, treated the patient during July, after the bed sores had formed, and I made the autopsy at his request and that of Deputy Coroner Dr. Shine.

After hardening in bichromate of potash, sections were made in various regions of the encephalon and cord in Case I. In the brain proper, small patches or nodules of sclerosis 1 to 3 mm. in diameter exist in various parts of the white substance of the hemispheres; and there are a few just under the gray cortex. In the right nucleus caudatus, near the posterior margin, are several nodules; in the right occipital lobe just outside of the posterior horn of the lateral ventricle, extending well back toward the convolutions at the apex of the lobe, is a long sclerosed patch.

Pons and Medulla.—The upper part of the pons varolii and crura have not been critically examined. In the medulla oblongata the sclerosis appears in the following parts:

1. At the level of the apex of the fourth ventricle (Fig. 5), and below, a patch about 2 mm. exists in the very centre of the section across the median raphe.

2. In a section made at a point 6 mm. above the apex of the fourth ventricle (Fig. 6), a large patch of sclerosis invades the floor of the ventricle, including the mass of gray matter which gives origin to the hypoglossus, par vagum, and glossopharyngeal.

Few cells of the hypoglossus nucleus are visible, and these are small and rounded.

3. In a section made through the point of origin of the 6th and 7th nerves at about 2 mm. above the inferior border of the pons varolii, the sclerosis is found in about the same location, viz.: round about the nucleus of origin of these nerves under the floor of the fourth ventricle (Fig 7).

Cord.—Sections have been made in the cervical, dorsal and lumbar regions, stained in carmine and hematosin, and mounted in Canada balsam. With a low power or with the naked eye the following distribution of the lesion can be made out:

In the cervical region (Fig. 1), the sclerosis involves the following districts: Almost all the right anterior column, and the entire anterior horn, the posterior part of the left anterior column, and the whole of the anterior horn, the posterior part of the lateral column, a narrow band of cortical sclerosis of both posterior columns, the lower part of the columns of Tuerck near the commissure; all the gray commissure involved in the disease.

In a section a little below this in the *cervical region* (Fig. 2), the location of the lesion is somewhat different. The most decided disease is confined to the anterior part of the left anterior column, a small part of the external edge of the anterior horn, the posterior part of the lateral column, the columns of Goll and the gray commissure.

In the dorsal region (Fig. 3), decided sclerosis of outer part of left anterior column and the whole of the anterior horn, the columns of Tuerck, and a slighter sclerosis of all the cord posterior to a line drawn through the central canal.

In the lumbar region (Fig. 4), the right anterior column and border of the anterior horn, the posterior part of the right lateral column, both posterior columns, gray commissure, and slight sclerosis of the periphery of left anterior horn.

In Case II., only the spinal cord was obtained.

In the cervical region (Fig. 8), the following districts are diseased: The columns of Tuerck, posterior part of right anterior column, the upper part of right column of Burdach, the columns of Goll, posterior part of left anterior column.

Sections just below above in the cervical region (Fig. 9), show

the following distribution: The columns of Tuerck, part of right anterior and lateral column, the entire posterior columns, the periphery of the right anterior horn.

Dorsal region (Fig. 10), columns of Tuerck, the periphery of both anterior horns; the gray commissure, both lateral columns and both posterior columns.

In the lumbar region (Fig. 11), the columns of Tuerck, right lateral column, posterior part of left anterior column, entire posterior column, the periphery of both anterior horns. It will be seen from this description that the sclerosed nodules are of various sizes, and occupy the most diverse regions of the cerebro-spinal system, involving the gray as well as the white matter.

Histology.—The histologic study will include the two cases.

For convenience of study and description we will divide the morbid process into three (3) stages. This division, although arbitrary, can nevertheless be observed on a close study of the specimens, and aids very much in a description and the understanding of the various conditions which are observed in the many diseased regions of the cerebro-spinal substance: *

The first stage will comprise the very earliest changes which are to be observed.

The second stage in which the morbid process has advanced considerably.

The third stage in which the most extensive changes are to be seen.

The Neuroglia.—1st Stage. An examination of the neuroglia of the white matter at this stage, shows an increase in the size of the nuclei, their number is also slightly increased; there is an increase of the protoplasm around the nuclei; the quantity varying very much in different cells, in most of the cells it is only a little greater than normal, in a few it is enormously increased, as can be seen in Fig. 12, representing two cells seen in the anterior columns of the dorsal region in Case I. The nuclei have not only undergone increase in their size, but they have also assumed the most diverse shapes; in those cells

*The medulla and pons were examined by Dr. Seguin, the two cords and brain by Dr. Shaw.

Fig 1.

Fig 10.

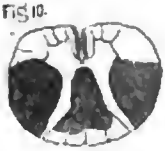

Fig 11.

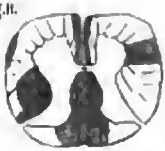

Fig 12.

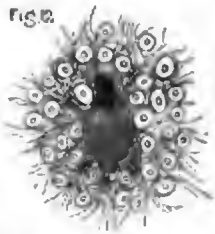

Fig 2.

Fig 15.

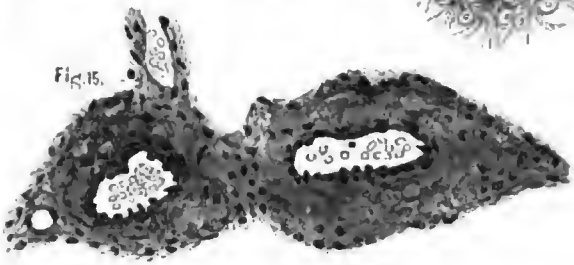

Fig 3.

Fig 4.

Fig 13

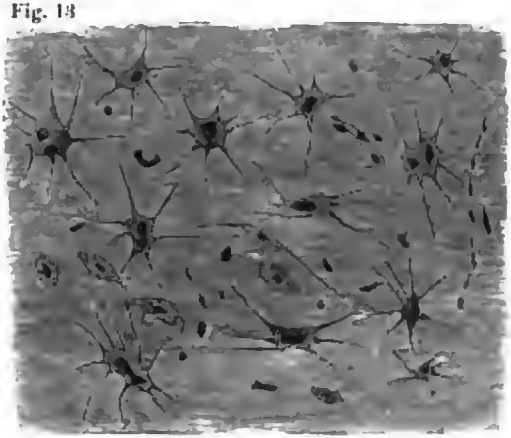

Fig 5.

Fig 6.

Fig 7.

Fig 14

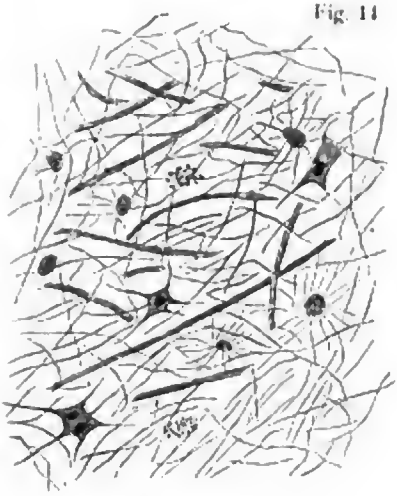

Fig 16.

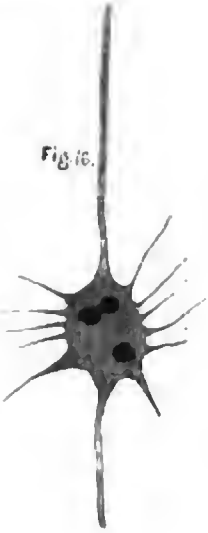

Fig 8.

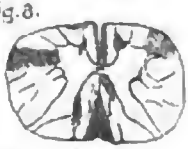

Fig 9.

where the protoplasm is very much increased, the nucleus is found at the extreme edge, as if the protoplasm had increased all on one side; we also begin to notice slight processes from the protoplasm; even now there is an appearance of increase in the size of the fasciculi of tissue running between the various areas of nerve tubes. At this time all the surrounding nerve tubes appear to be normal, their axis cylinders and myelinic sheath are perfectly distinct. In the gray matter at this period, the alterations are very similar: a slight increase in the size of the nuclei and the protoplasm around them, and beginning to be visible processes from the protoplasm.

In the second stage, the nuclei and their surrounding protoplasm have increased in size, their processes are now much larger, and more distinct and apparently more numerous; and there is altogether a much larger number of these branching cells visible. There is now present a diffuse granular appearance; no special fibrillation to be seen; a very close observation shows that the axis cylinders are present but that their myeline sheaths have gone. (The granular appearance at this period is very probably due to the breaking up of the myelinic sheath into a granular looking material which becomes diffused among the surrounding tissue, and this perhaps also explains why we do not see the increased fibrillation of the neuroglia.) The process at this period is the same throughout the brain and cord; in the gray as well as in the white matter.

In the third stage, these branched cells have grown to an enormous size, their processes are numerous and sometimes of immense thickness and length (Fig. 13); now very little granular material is present, and we see distinctly the enormous increase of neuroglia fibres, and which are of exceeding coarseness; there appears to be no evidence of anastomosis between them. In a stage a little advanced of this (Fig. 14), these branched cells appear much less numerous, they are less distinct, their nuclei are less sharply stained, their outlines are not so perfect, and they sometimes appear as imperfect bodies; they in their turn, appear to have lived their day, and are now undergoing decay.

Nerve Fibres.—In the second of the artificial periods, which

we have created for convenience, we see the first changes in the nerve fibres, their myeline sheath is undergoing disorganization; but their axis cylinders still remain.

In the third period, when the increase of neuroglia fibres is at its greatest height, we still see among its coarse fibres numerous axis cylinders, in good preservation (Fig. 14); this preservation of the axis cylinders, is considered almost distinctive of disseminated sclerosis by Professor Charcot. Charcot states that the axis cylinders have become hypertrophied; this is a matter which appears open to question.

Ganglion Cells.—The following description holds good for the ganglion cells in the entire cord. In the decidedly diseased portions there is a remarkable absence of processes; but it happens occasionally, even in a markedly sclerosed area, that a cell will be seen whose process is apparently normal, and can be traced for a considerable distance; most of the cells contain more or less yellow pigment, some are almost entirely filled with it, and no nucleus is visible; in other cells the pigment is seen encroaching on the nucleus; in some cells the nucleus is seen with clear and definite outline; in many other cells they present an indistinct jagged edge, and occasionally they appear to be making an effort at budding.

In some cells all the nucleus appears to have undergone a form of dissolution, as it presents a very broken appearance. In a number of cells the nucleus is displaced, sometimes almost into one of the large processes, in others to the extreme edge of the cell. In a markedly sclerosed area in the anterior horn of the cervical region, the cells have undergone a simple diminution in size, so that they are reduced to at least one-third. The cells in the columns of Clarke have undergone the same changes. The alteration in the cells is greatest in Case II.

Vessels.—In Case I. the muscular coat of the arteries are very much hypertrophied, there is also some increase in the intima and adventitia and an increase in the number of nuclei; the lumen of the artery is therefore rendered much smaller than normal. (Fig. 15.)

In Case II. the arteries have also undergone the same changes; although the muscular coat is not nearly as much hypertrophied, and the lumen of the artery is much larger.

In comparing the arterial changes in these two cases we find that in Case I. the arterial change is greatest, and the sclerosis less marked, whilst in Case II. the sclerosis is most decided and the arterial change much less.

The nuclei of these branching cells are very sharply stained by the hematosin, whilst the body is very lightly stained; they have slightly granular contents; these nuclei present the same appearance at all stages of the process. The cells contain 1, 2, 3 and even 4 nuclei of irregular shape; and often nuclei are seen with partial constrictions on them as if they were about to divide; the nucleus is most usually placed to one side of the cell. The processes which are given off from these cells are very numerous, and always leave the cell by a broad base, tapering off to a hair-like extremity, which becomes lost in the surrounding tissue. The shape of the cells, and the manner in which the processes are given off, varies very much; some cells are to be seen with only two processes, one at each end.

Other cells have a rather long body, and many processes given off from each end; but the majority of cells have processes from all sides. Two of the cells seen are of enormous size, having a process of very great thickness, which can be seen for quite a distance and does not taper off like the other processes. (Fig. 16.)

There are besides these branching cells small nuclei in more or less large number and of a variety of shapes; but mostly round and sharply stained. These curious branching cells have been seen by other observers. Lubimoff and Micrzejewski have described them in the cerebral substance of general paralytics. Charcot and Gombault in a case of syphilitic disease of the protuberance. Pierret in a case of myelitis. Debove appears to have seen them in a sclerosed patch of the ependyma ventriculorum. They are to be seen in a case of central myelitis with cavities from a patient of Dr. Seguin's.

Lubimoff, Beitraege zur patholog. Anatomie der allgem. progressiven Paralyse, *Archiv fuer Psych. und Nervenk.*, Band 4.

Mierzejewski, Etude sur les lesions cerebrales dans la Paralysie Generale, *Archives de Physiologie*, Tome 2, 1875.

They have been figured by Jastrowitz* in an article on "Study of Encephalitis and Myelitis in young children." Adler† has also figured them. The cells figured by Jastrowitz are very similar to those seen by us. Mierzejewski describes these cells as being connected with the walls of blood vessels. We have observed them in the vicinity of blood vessels and sending their processes towards them, but it is very difficult to determine in this case whether they unite with the wall of the vessel or not. They have no special predilection for the neighborhood of vessels, but are to be seen every where. Pierret describes them as anastomosing; we have not seen any anastomoses between our cells.

Frommann figures, in sclerosis of the cord, cells somewhat similar; but they have fewer processes and are very much smaller than the cells observed in our cases; 500 to 950 diameters made them distinct; their protoplasm is not so abundant.

The interest attaching to these cells is in knowing if they are normal elements of the neuroglia which have become hypertrophied. In looking over the records of pathological cases which have preceded, and the many recent observations in normal histology of the neuroglia, there appears good reason for believing that these are really normal elements of the neuroglia which have become hypertrophied. The cells, with hair-like processes, figured by Boll‡ and Deiters. Those depicted by Frommann, although containing a much larger number of fine processes and a nucleus surrounded with very little protoplasm, might be supposed to have undergone a modification so as to present the appearances of our cells.

Butzke§ figures cells with processes from the normal neuroglia, which on the whole, have a much closer resemblance to the cells just described by us than any others we have seen.

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* Jastrowitz, *Archiv fuer Psych. und Nervenkrankheiten*, Band 3.

† Adler, Ueber einige path. Veraenderungen an den Hirngefaessen Geisteskranken, *Archiv fuer Psych. und Nervenkrankheiten*, Band 5.

‡ Boll, Die Histiologie und Histiogenese der nervosen Centralorgane, *Archiv fuer Psych. und Nervenkrankheiten*, Band 4.

§ Butzke, Studien ueber den feineren Bau der Grosshirnrinde, *Archiv fuer Psych. und Nervenkrankheiten*, Band 3.

His cells have a good sized nucleus with a considerable amount of protoplasm around them, and numerous fine processes with one or two large ones which do not taper off to fine points, and resemble very much the large one figured by us, as seen in the posterior part of the lateral column in the cervical region.

Explanation of Figures.—Figures 1 to 11. Sections from various regions of both spinal cords, showing the various distribution of the sclerosed patches. Verick No. 2. Eye piece 3.

Fig. 12. A neuroglia cell in the white matter of the spinal cord; increase in the size of the nucleus, with an enormous increase of the protoplasm around it. 1st stage.

Fig. 13. From a section through the corpus striatum; a large number of branching cells are seen distributed in a somewhat coarse mesh of neuroglia fibres; one or two cells proper to the corpus striatum undergoing degeneration. 2d stage.

Fig. 14. Section from the brain; axis cylinders without a trace of myeline, lying in a very coarse, loosely arranged neuroglia fibre; a few branching cells showing all stages of degeneration. 3d stage.

Fig. 15. Showing transverse section of artery with hypertrophied muscular coat, and an increase of nuclei in all the coats.

Fig. 16. A very large branching neuroglia cell seen in the white matter of the cord; two nuclei are to be seen, one of which shows a constriction in the middle as if it were about to divide. Verick No. 7. Eye piece No. 3.

Art. VI.—CONTRIBUTION TO THE STUDY OF OSSIFICATION OF THE MENINGES.

By J. N. De Hart, M. D.,

Second Assistant Physician to the Hospital for Insane, Mendota, Wis.

CALCAREOUS plates situated on the cerebral membranes are frequently found in epileptics, and in lepto-meningitis of long standing as well as in pachy-meningitis. True ossification is rather rare, and it usually begins on the inner surface of the cranial bones, and presents itself in the shape of spiculæ of bone. In calcareous plates bone corpuscles are never found; in spiculæ and bony tumors they are always present.